Dehydration kinetics of hydrohalite

Bernhard Jost, Robert Hodyss, Paul V. Johnson

Jet Propulsion Laboratory
California Institute of Technology

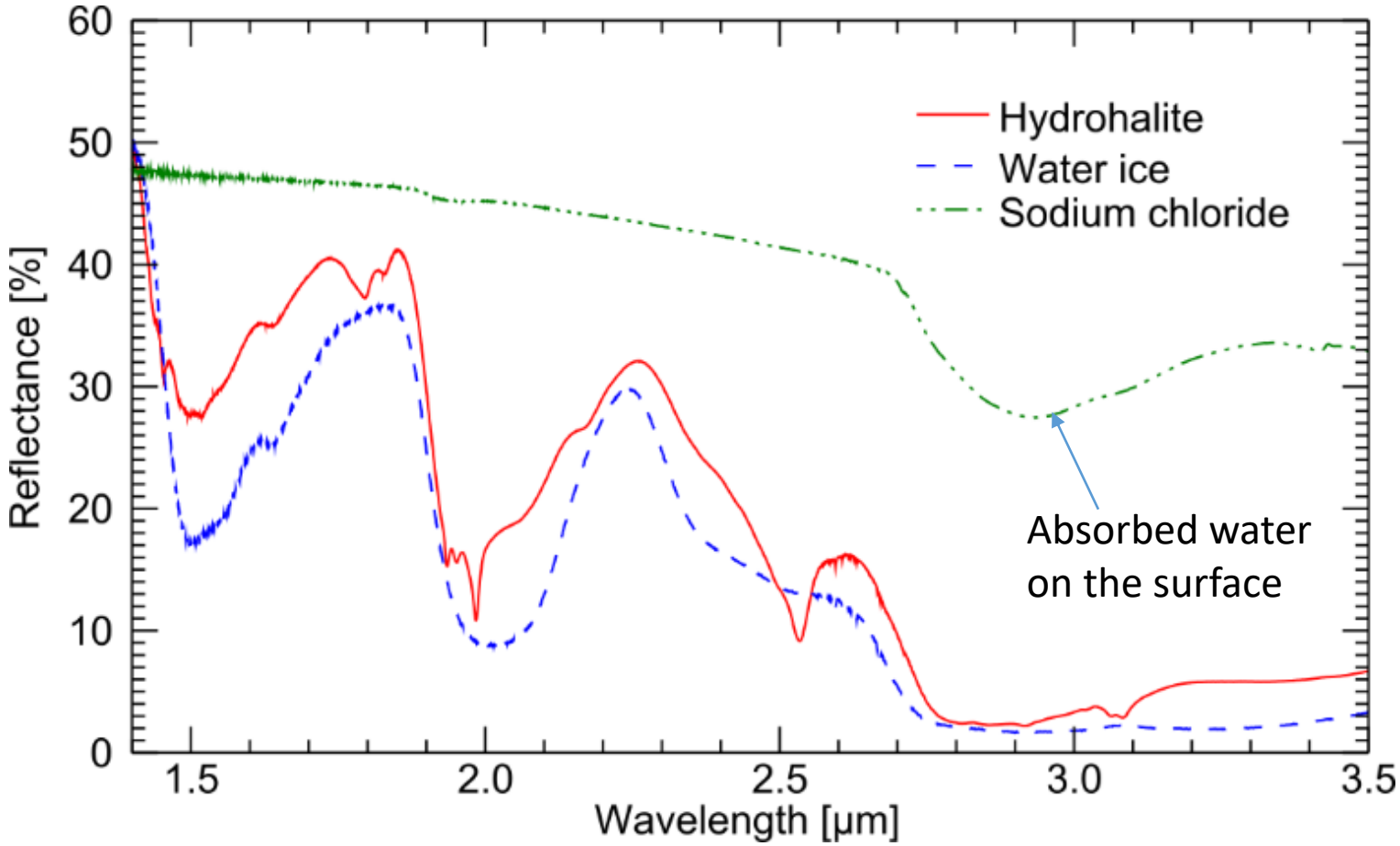
Motivation

- Mostly driven by upcoming Europa Clipper Mission
- Infer the surface history of Europa
- Link surface composition to ocean composition and subsurface geological processes
- Link observables from NIR spectroscopy to past and present aqueous environment, i.e. subsurface ocean outflows (Miyamoto et al. 2005) or potential plume deposits (Sparks et al. 2017)
- Build up a systematic catalog of laboratory measurements, with relevant timescales

Hydrohalite

- NaCl is one species of salt that has been proposed to exist on Europa (Kargel et al. 2000, Icarus)
- The NIR spectrum of anhydrous NaCl is flat and indistinct and therefore hard to detect from remote sensing
- Hydrohalite ($NaCl \circ 2H_2O$) forms in saturated NaCl solution below 268K
- Only stable hydrated state of sodium chloride under Europa conditions, other salts such as sodium- or magnesium-sulfates have numerous hydration states

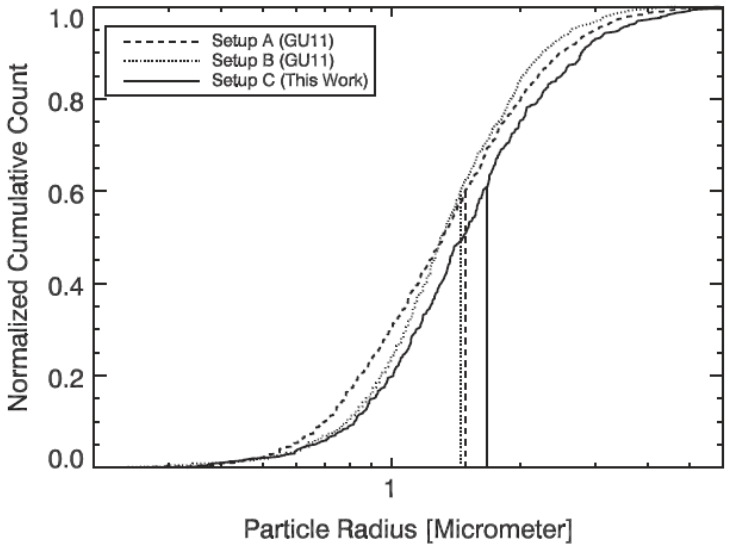
Hydrohalite



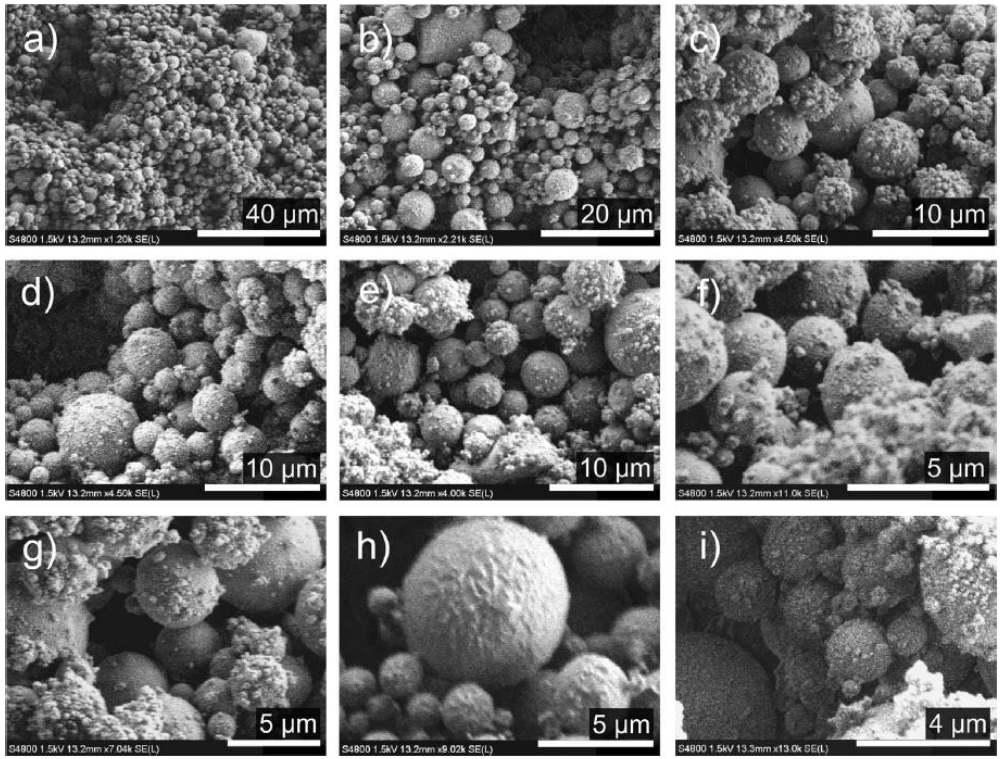
Variable parameters

- Grains size
- UV irradiation wavelength
- Temperature
- Electron energy

Sample production

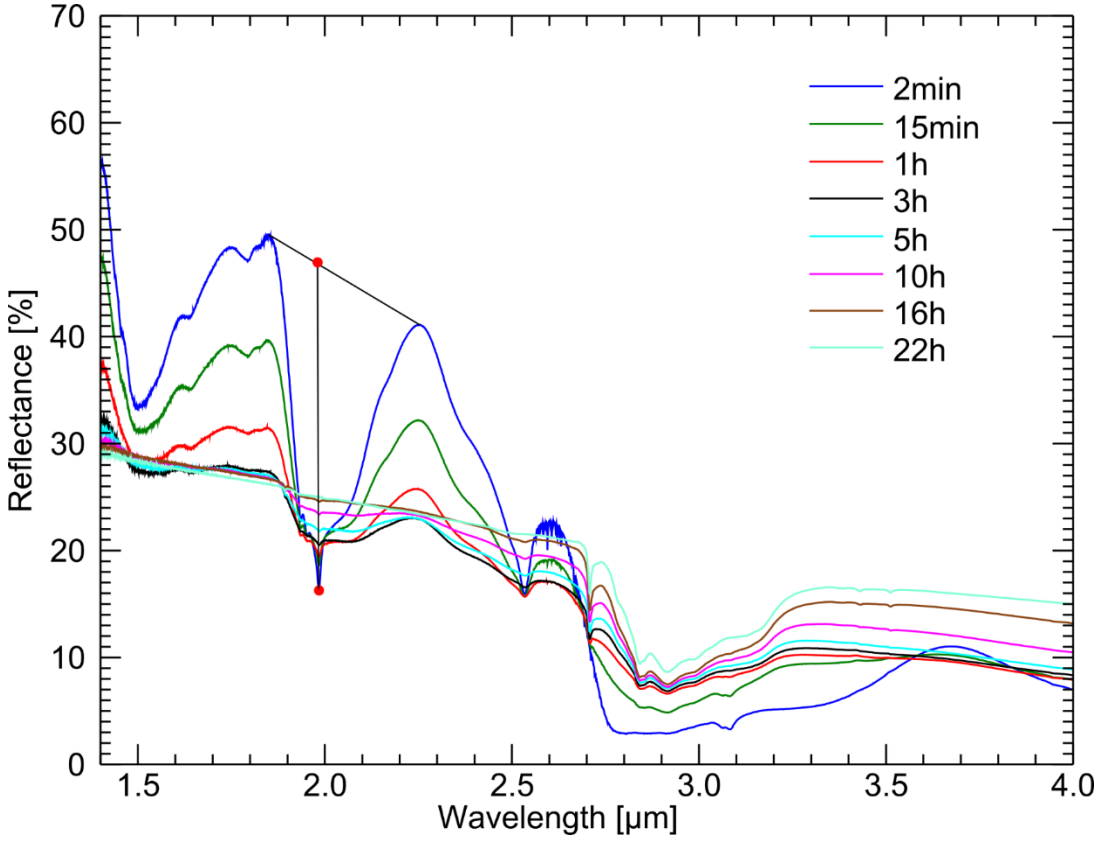


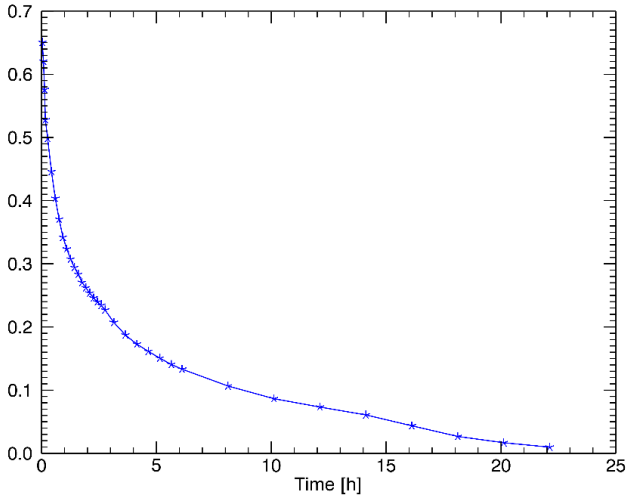
r= 1.47+0.96-0.58µm

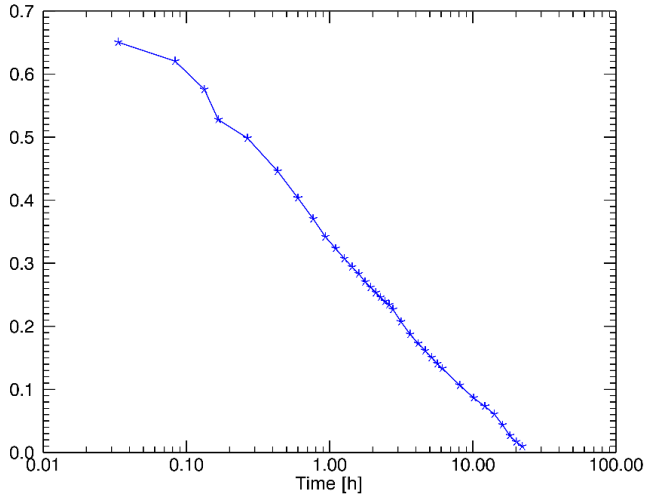


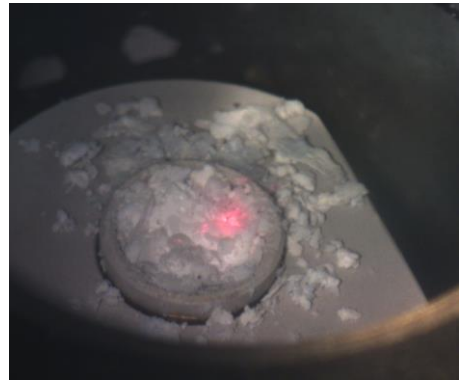
Jost et al., 2013, Icarus

Preliminary results



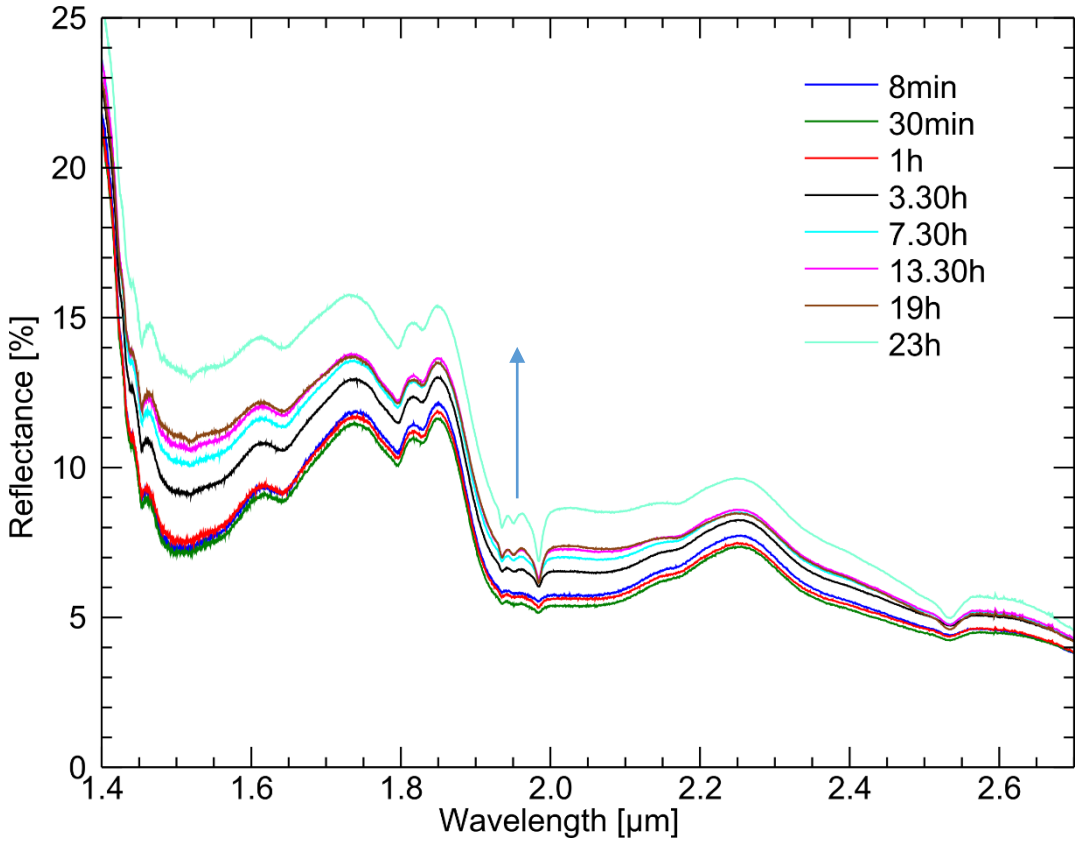




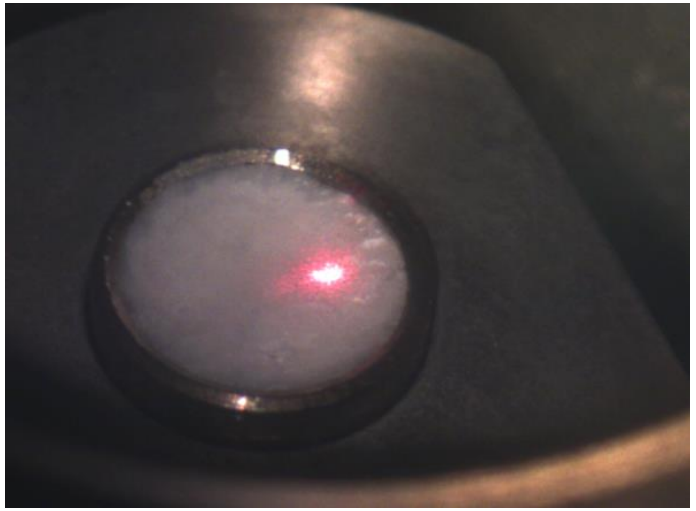


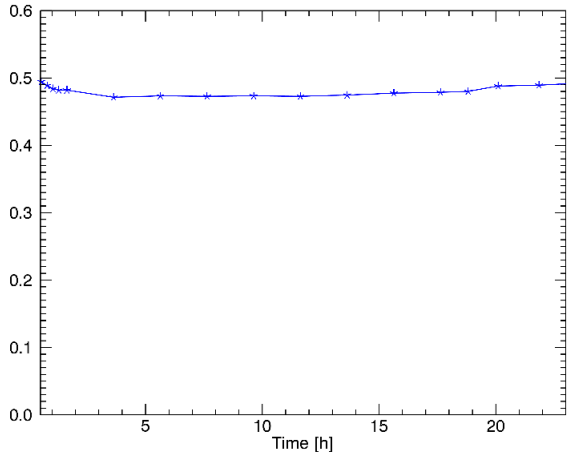
T=-110°C, P=2x10^{-3} mbar

Preliminary results



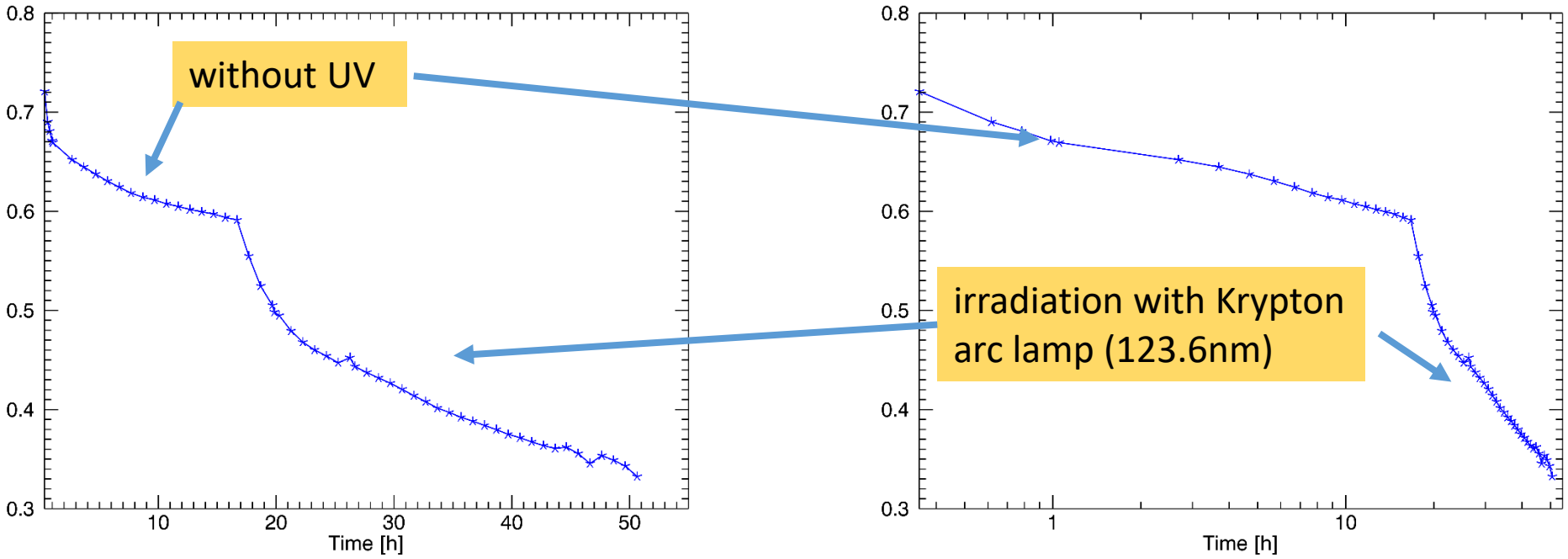
Brine frozen in side cryo-stage





T=-90°C, P=2x10^{-3} mbar

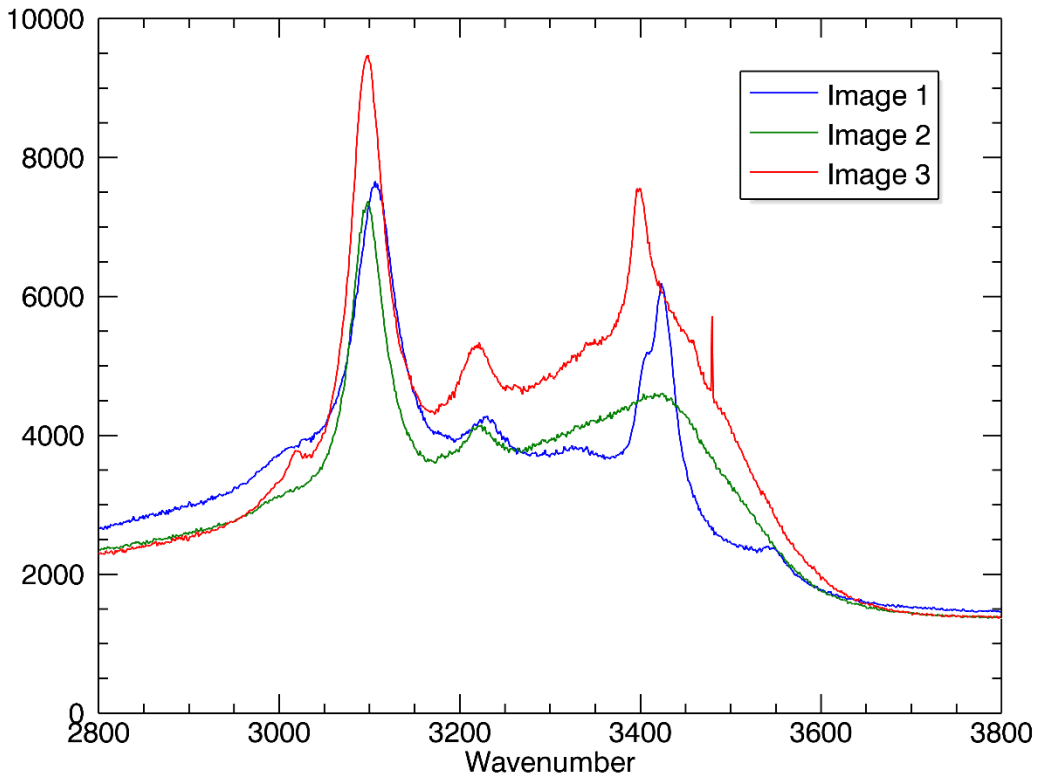
Preliminary results



T=-170°C, P=2x10^{-3} mbar

Preliminary results

Raman spectroscopy



T=-160°C, P=ambient

Problems, work to do

- The spectral detection of Hydrohalite by Europa clipper would constitute an unambiguous
- Apply different UV arc lamp: I_2, Xe, Hg

Summary

- The spectral detection of Hydrohalite by Europa clipper would constitute an unambiguous hint for very recent aqueous activity since hydrated salt minerals on the surface dehydrate relatively quickly in high-radiation environments
- Our current laboratory investigation tries to elucidate the relevant timescales for this processes
- Preliminary results show a strong temperature dependence as well as influence from morphological structure